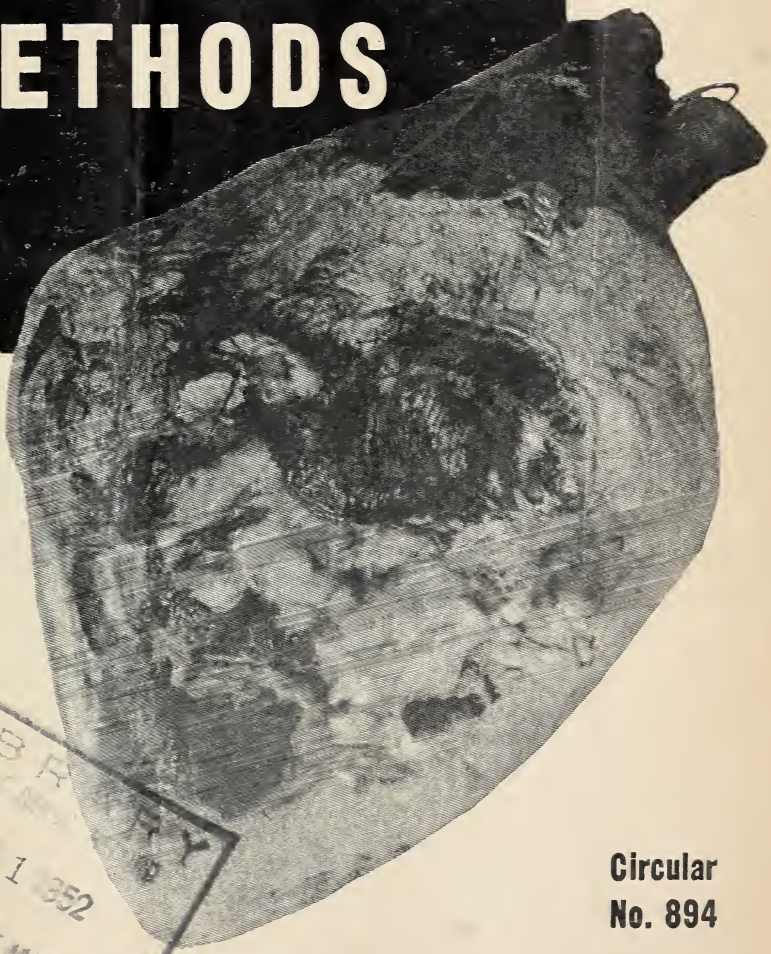
Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

LIBRARY
CURRENT SERIAL RECORD
JAN 15 1952
U.S. DEPARTMENT OF AGRICULTURE

A SURVEY of FARM MEAT-CURING METHODS



LIBRARY
CURRENT SERIAL RECORDS
JAN - 1 1952
U. S. DEPARTMENT OF AGRICULTURE

Circular
No. 894

U. S. Department of Agriculture

Circular No. 894

October 1951 • Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE

A Survey of Farm Meat-Curing Methods[1]

By C. F. Dunker, *meat technologist*, and O. G. Hankins, *principal animal husbandman, Animal Husbandry Division, Bureau of Animal Industry, Agricultural Research Administration*[2]

CONTENTS

	Page
Purpose and scope of survey	1
Farm-curing methods in use	2
Dry cure, no previous pumping	3
Brine cure, no previous pumping	6
Brine cure with previous pumping	7
Dry cure with previous pumping, commercial mixture	8
Variations in procedure in the different types of curing	8
Discussion	9
Summary	10
Literature cited	10

PURPOSE AND SCOPE OF SURVEY

About 12 million to 15 million hogs, yielding about 2 billion pounds of meat, are dressed annually by farmers for their own use, according to the Bureau of Agricultural Economics of the United States Department of Agriculture (*6*).[3] Much of this meat is cured and otherwise processed on the farm. As a part of a comprehensive study of processing in relation to preserving the quality of meats, a country-wide survey was made in 1948 to determine the most generally used methods of farm curing.

Based on the results of this study, cured meats produced by these methods will be obtained from farmers to determine any differences in flavor, color, tenderness, chemical composition, bacterial content, vitamin content, and growth-promoting value of the protein. Later, the typical methods of curing on the farm will be duplicated in experiments by the Bureau of Animal Industry in which meats from animals of known history and feeding will be used. Meats so cured will be analyzed for the same factors as were the samples obtained

[1] Report of a study made under the Research and Marketing Act of 1946.

[2] The authors wish to acknowledge the assistance of Emerson Brooks, Bureau of Agricultural Economics, for advice in arranging the questionnaire, as well as for supervision of its mailing to the farmers; of Herman Goldhammer, also of the Bureau of Agricultural Economics, for supervising the recording of data on punch cards and the subsequent sorting and tabulation work; and of Clarence Chapman, Greenbelt High School, for assisting in analyzing the data.

[3] Numbers in parentheses refer to Literature Cited, p. 10.

960747°—51

from the farmers. Finally, based on the results, an effort will be made to develop new or improved methods for retaining the quality of farm-cured meat. This circular is concerned only with the typical methods used in farm curing.

In conducting this survey, the Bureau of Agricultural Economics, cooperating with the Bureau of Animal Industry, mailed questionnaires to 14,468 farmers to determine whether they cured meat. Of about 5,000 farmers who responded, 2,817 answered in the affirmative. To this latter group, a second questionnaire concerning detailed methods used in curing was mailed, and 1,855 farmers responded. Of these returns, 1,315 were usable, and the findings presented in this circular are based on them.

FARM-CURING METHODS IN USE

Four general farm-curing methods are employed, as shown in table 1 and figure 1. The largest group of those included in the survey dry-cured meat without previous pumping. Second in point of numbers was the group that brine-cured without previous pumping. About one-half of the group that dry-cured meat used table salt only, and the remaining half was divided rather evenly between farmers who used a commercially prepared mixture and those who used a home mixture. The group of farmers who brine-cured meat without pumping employed as the curing agent either fine table salt, a commercially prepared mixture, or a home mixture. Those who brine-cured meat after it had been pumped used a commercially prepared mixture or a home mixture. When meat was pumped and dry-cured a commercially prepared mixture was used. When all types of curing were considered together, two-fifths of the farmers throughout the country used salt only, one-fourth used a commercial mixture, about one-fifth used their own home mixture, and the remainder used miscellaneous curing methods or did not mention the type of curing agent.

Figures 2 and 3 show the geographic distribution of dry and brine curing in the country, by sections and by States, the latter being arranged in accordance with the amount of dry curing. The South Atlantic and South Central States, which account for about 60 per-

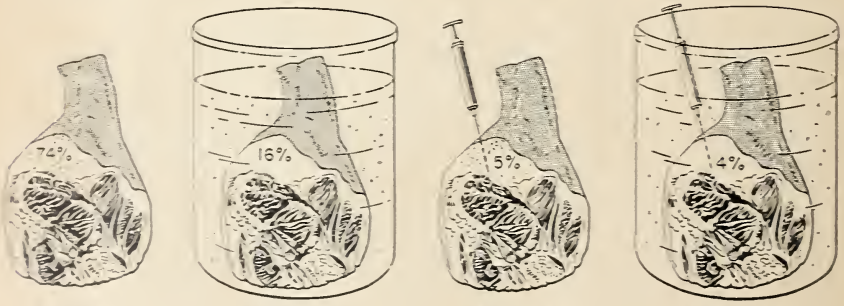


Figure 1.—Four methods used in farm meat curing and the percentage of farmers using each method.

TABLE 1.—*Percentages of farmers using various methods of farm meat curing (based on 1,315 returns)*

Curing agent	Dry cure, no pumping	Brine cure, no pumping	Brine cure, pumping	Dry cure, pumping	All methods
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Table salt	37	4			41
Commercial mixture	18	2	2	4	26
Home mixture	17	4	1		22
Miscellaneous [1]	2	6	1	1	10
Total	74	16	4	5	[2] 99

[1] No details given as to curing agents used.
[2] One percent, not included in table, stated only that they pumped the meat and gave no further details as to method of curing.

cent of all meat cured, are predominantly dry-curing States. The New England States, which cure less than 3 percent, are predominantly brine-curing States. The Great Lakes States, including Pennsylvania and New York, cure, by both dry and brine methods, about 28 percent of all meat cured. The Western States, which cure about 9 percent, also use both dry and brine methods. Pennsylvania reported the greatest amount of curing of any State, about 6.7 percent, more than half of which was done by the dry method. Tennessee reported the second greatest amount of curing, 6.0 percent, almost all of which was by the dry method.

Hams, shoulders, and bacons were the most commonly cured cuts. Only one of every five farmers cured other pork cuts. Practically no beef was cured on the farm. Most farmers cured two to eight pieces of each cut.

DRY CURE, NO PREVIOUS PUMPING

Figure 4 shows the relative amounts of the various curing ingredients per 25 pounds of meat used in the three methods of dry curing with no previous pumping. About three of every four farmers included in the survey used one of these methods when curing meat.

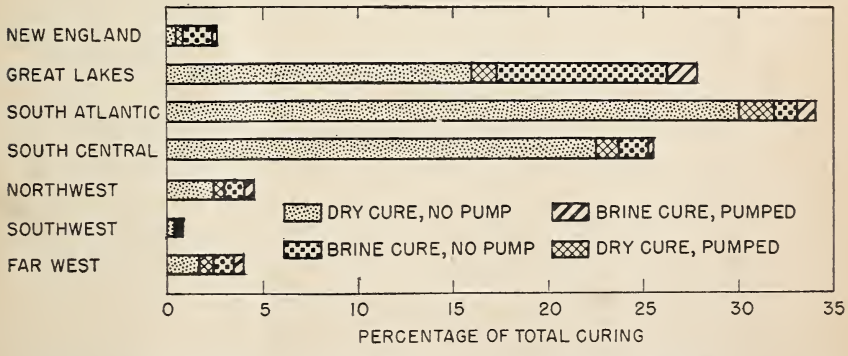


FIGURE 2.—Percentage of each of the four curing methods used by the various sections of the country, based on the total amount of curing on farms.

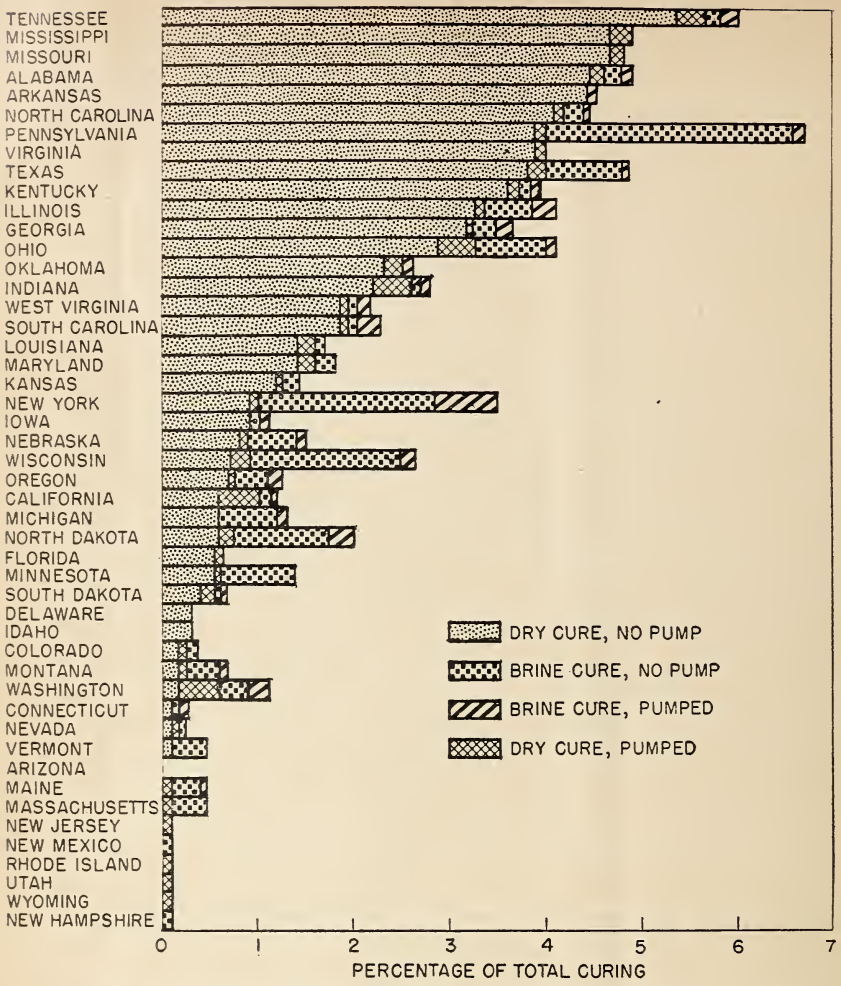


FIGURE 3.—Percentage of each of the four curing methods used by the various States, based on the total amount of curing on farms.

SALT ONLY

In the dry-curing method, used by 37 percent of the farmers, the curing agent was a fine grade of sack salt or table salt applied to hams, shoulders, and bacons. All the salt was applied at one time by about one-half of the farmers, 10 pounds of dry salt per 100 pounds of meat being used. The liquid extracted from the meat during cure was not permitted to accumulate. Curing temperatures ranged from 20° to 50° F., the average being about 40°. Most hams weighed 20, 25, or 30 pounds; shoulders and bacons weighed 20 pounds. The hams were cured for 1½ days per pound; shoulders and bacons, 1¾ days. About 50 percent of the farmers smoked their meat. Prior to smoking 3 to 4 days in hickory smoke, the meat was washed. The meat was stored

in a dry, cool room with some air circulation. Consumption began immediately after the meat was cured and smoked, although some meat was stored for 9 months.

COMMERCIAL MIXTURE

About 18 percent of the farmers dry-cured their meat with a commercial mixture and used no previous pumping. About three-fourths of these used a mixture containing salt, sugar, nitrate, spices, and condensed wood-smoke products. The remaining 25 percent used a similar mixture containing no smoke products. The typical method of curing was essentially as follows: Hams, shoulders, and bacons

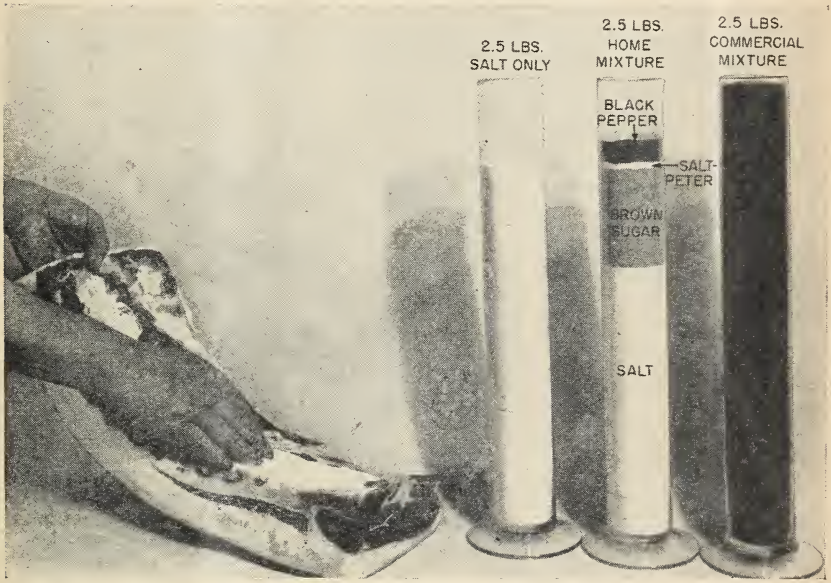


FIGURE 4.—Relative amounts of the various curing ingredients per 25 pounds of meat used in the three methods of dry curing with no previous pumping.

were rubbed with 10 pounds of dry mixture per 100 pounds of meat. About 50 percent of the farmers applied all the dry mixture at one time. During cure the liquid extracted from the meat was permitted to drain away. The average curing temperature was 38° to 44° F. Hams and shoulders weighed 20 pounds and were cured for 1½ days per pound of meat, and bacons weighed 15 pounds and were cured for 2 days per pound.

After curing was completed, the meat was washed with water to remove the excess curing agents. The 75 percent of this group that used a commercial mixture containing condensed smoke ingredients dispensed with the smoking operation. The remaining 25 percent smoked their meat 2 days in hickory smoke. Consumption of the meat was begun immediately after cure, although some meat was stored 9 months before being used. The cured meat was hung in the smokehouse during storage or wrapped in paper or cloth and stored in a cool,

dark room with some air circulation. The storage temperature ranged from 40° to 60° F.

HOME MIXTURE

In dry-curing meat with a home mixture and no previous pumping—a method used by 17 percent of all the farmers—the mixture consisted partly or entirely of the following ingredients: Salt, brown or white sugar, black or red pepper, and saltpeter. Of the group using this method, 95 percent included pure table salt as part of their home mixture; 84 percent included sugar (67 percent used brown sugar, 3 percent used white sugar, and 14 percent did not identify the kind); 75 percent included pepper (43 percent used black pepper, 27 percent used black and red pepper, and 5 percent used red pepper); 49 percent included nitrate; and 11 percent added salt or other ingredients to commercially prepared mixtures.

The home mixtures, in descending order of their popularity, consisted of the following combinations: (1) Salt, brown sugar, black pepper, saltpeter; (2) salt, brown sugar, black or red pepper; (3) salt, brown sugar, black and red pepper; (4) salt, brown sugar, black and red pepper, saltpeter; (5) salt, brown sugar, red pepper, saltpeter; and (6) salt, pepper, saltpeter. The mixture used by most farmers consisted of the following: Salt 10 pounds, brown sugar 3 pounds, black pepper 6 ounces, and saltpeter 3 ounces.

Hams, shoulders, and bacons were rubbed with 10 pounds of the dry mixture per 100 pounds of meat. Approximately two-thirds of the farmers using a home mixture applied all of it at one time. During cure the extracted liquid was permitted to drain away from the meat. The average curing temperature was 28° to 40° F. Most hams weighed 21 to 25 pounds, shoulders and bacons weighed 20 pounds. Hams and shoulders were cured for about 1½ days per pound of meat, and bacons for about 2 days. After curing, the excess curing agents were removed by washing with water. Approximately one-half of the farmers smoked their meat for 3 days in hickory smoke. Meat was stored as long as 9 months at 23° to 70°. The stored meats were hung in the smokehouse or wrapped in paper or cloth and kept in a cool, dark room in which there was some air circulation.

Brine Cure, No Previous Pumping

SALT ONLY

This group, consisting of 4 percent of the total farmers reporting, used table salt to prepare a 74° salinometer brine, or one sufficiently strong to float an egg. (Laboratory experiments have shown that some eggs float and some sink in a 45° brine but that all float in a 60° brine). Hams weighed 15, 20, and 30 pounds; bacons, 10 pounds; and shoulders, 20 pounds. The procedure was to use 5 gallons of brine per 100 pounds of meat and cure it for 2 days per pound at 36° to 40° F. Of the farmers using this method, 56 percent did not repack the meat. After curing was completed the meat was washed, and it was subsequently smoked by 43 percent of the group. Hams and shoulders were smoked for 3 days and bacons for 3½ days. Meat was wrapped in paper bags, brown paper, or cloth and stored in a dark, dry room with some air circulation at 40° to 90°.

COMMERCIAL MIXTURE

Of the farmers reporting, only 2 percent used a commercial mixture in brine-curing their meat with no previous pumping. In most instances the mixture contained condensed wood-smoke products. A 70° salinometer brine (2 pounds of mixture per gallon of water) was prepared and the meat was cured for about 2 days per pound at 35° to 41° F. In this group 57 percent of the farmers repacked their meat, and after cure was completed 44 percent smoked the product. All cuts were smoked for 3 days, packaged in paper or cloth, and stored in a dry, dark room with air circulation.

HOME MIXTURE

In brine-curing meat with a home mixture and no previous pumping—a method used by 4 percent of the farmers—the typical mixture consisted of 8 pounds of salt, 2 to 3 pounds of brown sugar, and 2.2 ounces of saltpeter in 4 gallons of water (about 79° salinometer brine). The hams, shoulders, and bacons were covered with 9½ gallons of brine per 100 pounds of meat. The meat was not repacked during cure, which was carried out at 34° to 45° F. Hams weighed 18 pounds, shoulders 14 pounds, and bacons 8 pounds, and were cured respectively for 2 days, 2½ days, and 4 days per pound. After cure, the meat was washed and then smoked for 6 to 7 days with the use of hickory as fuel. The meat was left in the smokehouse during storage or wrapped in paper or cloth and stored in a dry, dark, ventilated room for 9 months at 30° to 61°.

Brine Cure With Previous Pumping

COMMERCIAL MIXTURE

These farmers, constituting 2 percent of the total number reporting, pumped their meat with a commercially prepared mixture and then brine-cured with a commercial mixture. The procedure, as given on the package, was to pump the meat to about 8 percent net weight with an 85° salinometer brine and then place the meat in a 70° salinometer brine containing condensed smoke products. Hams and shoulders were cured for 2 days per pound. After curing the meat was washed. Of this group, 55 percent did not smoke their meat; the remaining 45 percent smoked it for 2 to 3 days. The meat was stored in a dry, dark, ventilated room at temperatures of 21° to 55° F.

HOME MIXTURE

Only 1 percent of the farmers included in the survey reported that they pumped and brine-cured meat with home mixtures. The mixtures used by this group were the following: For pumping, 9 pounds of salt, 2.5 pounds of brown sugar, and 2 ounces of saltpeter; for brine curing, 8 pounds of salt, 3 pounds of brown sugar, and 2 ounces of saltpeter. The procedure followed was to pump the meat to 4 percent net weight with a 70° salinometer brine and cover with a 60° salinometer brine, using 7 gallons per 100 pounds of meat. The temperature of the pump brine was 47° F., and the curing temperature 31° to 43°.

Hams weighing 20 pounds were cured for 1½ days per pound, and 16-pound shoulders and 11-pound bacons were cured for 2 days per pound. In general, after curing, the meat was washed, smoked for 1 to 2 days per pound, and wrapped in paper and stored as long as 9 months in a dry, dark, ventilated room at temperatures of 21° to 61°.

Dry Cure With Previous Pumping (Commercial Mixture)

This group, constituting 4 percent of the total, used a commercially prepared mixture both for pumping and dry curing. The pumping brine was prepared by adding 1 pound of dry mixture to 2 quarts of water. A sugar cure including condensed smoke products was used for dry curing. The typical method was to pump the hams to an increase of 2 to 4 percent in weight, with the brine at a temperature of 46° to 50° F. The meat was rubbed with 10 pounds of dry sugar cure, applied in two or more applications, and during cure the liquid extracted from the meat was permitted to drain away. Hams weighing 21 pounds were cured for 1½ days per pound, and shoulders weighing 16 pounds and bacon 13 pounds were cured for 2 days per pound. Few of these farmers smoked their meat, which was wrapped in cloth and stored in a dark, dry, ventilated room as long as 9 months at temperatures of 0° to 95°.

VARIATIONS IN PROCEDURE IN THE DIFFERENT TYPES OF CURING

Curing temperatures ranged from 16° to 60° F., the average being 35° to 41°. At no time was curing carried out entirely at either extreme of the temperature range.

In dry curing, 1 to 99 pounds of curing mixture per 100 pounds of meat were used, 10 pounds being used most frequently. Approximately one-half of the farmers applied all the mixture at one time. During the dry-curing operation, the liquid drained away from the meat, according to 80 percent of the farmers.

The hams used for curing weighed 6 to 50 pounds, averaging 21 pounds. Shoulders weighed 4 to 45 pounds, averaging 18 pounds, and bacons weighed up to 50 pounds, averaging 14 pounds. Meats were dry-cured for 1½ to 1¾ days per pound and were brine-cured for 2 days per pound.

About one-half of the farmers smoked their meat after curing. When a commercial cure containing condensed wood-smoke products was used, smoking was dispensed with.

After curing and prior to smoking, the meat was washed to remove excess curing agents adhering to the surface. Meat was smoked 1 to 30 days, usually 3 to 4 days. Hickory was generally used for fuel for smoking; oak was used by about 20 percent of the farmers. After curing and smoking, consumption of the meat was begun immediately by more than 50 percent of the farmers, and most of the meat had been used by the end of 9 months' storage. The meat was hung in a smokehouse during storage or wrapped in paper or cloth and stored in a dry, dark room having some air circulation. A few farmers packed the cured meat in lard or used skipper repellent.

DISCUSSION

According to this survey, only 3.2 percent of the farmers lost cured meat from spoilage. Of this group, 1.9 percent lost hams only; 0.3 percent lost shoulders only; 0.1 percent lost bacons only; 0.4 percent lost hams and shoulders; 0.2 percent lost pork cuts other than hams, shoulders, and bacons; 0.2 percent lost hams and bacons; and 0.1 percent lost shoulders and other miscellaneous pork cuts. However this total loss may be too low. Rodgers and Haynes (*5*) quote Brady as stating that "in North Carolina alone 10,000,000 pounds of cured meat spoiled annually, and that the amount of spoilage in the United States is unbelievably large." An analysis of the meat-curing methods used by farmers, as reported in this circular, shows why much farm-cured meat may not be of top quality, and why more cured meat spoils than is necessary.

As already indicated, more than 40 percent of the farmers reporting in this survey use only table salt or fine sack salt as the curing agent. Brooks and coworkers (*1*) and Dillon (*3*) believe that this often results in a product lacking red color and having a salty or briny taste and a tougher quality than would be obtained by the use of sugar and saltpeter in conjunction with salt. When dry-curing meat, approximately one-half of the farmers apply all the dry mixture in one application (one rub), although a more uniform and complete cure is assured by dividing it into two or more applications. Similarly, only about one-half of the farmers repack their meat during brine-curing—again a frequent source of uneven and incomplete curing. The survey showed that most meat is dry-cured only 1½ days per pound, whereas the recommendation by Warner (*7*) and Ziegler (*9*) is to cure 2 days per pound; and when brine is used the meat is cured for only 2 days per pound, whereas Warner (*7*) and the Committee on Recording of the American Meat Institute (*2*) recommend curing 3 to 4 days per pound.

Since much of the meat is cured in the Southern States, where temperature conditions are often unfavorable, a high percentage of spoilage is to be expected unless the best curing practices are carried out. Good curing operations include smoking, especially if the curing period has been too short, since White (*8*), Jensen (*4*), and other investigators have shown that the smoking operation partly dehydrates the meat, thereby increasing the salt-to-moisture ratio, which insures safer storage and produces better color, especially in bacon. Only about one-half of the farmers smoke their cured meats, though many of them hang them for further drying. The survey showed too that only 9 percent of the cured meat is pumped.

This great variety of pork-curing methods reported by farmers is one of the reasons for the many differences in the quality of farm-cured meat. It suggests the need for a more critical comparison of curing methods under farm conditions and more definite information on the efficacy, for farmers, of current curing mixtures, methods, and equipment.

SUMMARY

In 1948 a country-wide survey to determine the most generally used methods of farm-curing meats was made cooperatively by the Bureaus of Agricultural Economics and Animal Industry of the United States Department of Agriculture. More than 1,300 farmers who cured their own meat provided the information on which the study reported in this circular is based.

According to the reports, there are four distinct methods of curing meat: Dry cure with no previous pumping of the meat, brine cure with no pumping, brine cure with previous pumping, and dry cure with previous pumping.

Curing agents used are salt only; a home mixture containing various combinations of salt, sugar, pepper, and saltpeter; and a commercially prepared mixture.

The survey showed that about 80 percent of farmers dry-cure and 20 percent brine-cure their meat; only 9 percent pump their meat prior to dry or brine curing. Furthermore, only 50 percent of the farmers smoke their cured meat.

Dry curing is carried out predominantly in the South Atlantic and South Central States. The New England States are predominantly brine-curing States. New York, Pennsylvania, the Great Lakes States, and the Western States cure by both brine- and dry-curing methods.

The survey indicates that the great variety of curing methods used by farmers may account for the reported differences in quality of farm-cured meat.

LITERATURE CITED

(1) Brooks, J., Haynes, R. B., Moran, T., and Pace, J.
1940. the function of nitrite, nitrate, and bacteria in the curing of bacons and hams. Food Invest. Spec. Rpt. 49. 4 pp.

(2) Committee on Recording of the American Meat Institute.
1944. pork operations. Ed. 5, 413 pp., illus. Chicago, Ill.

(3) Dillon, C. E.
1947. meat slaughtering and processing. 307 pp., illus. Kansas City, Mo.

(4) Jensen, L. B.
1949. meat and meat foods. 219 pp. Chicago, Ill.

(5) Rodgers, P. D., and Haynes, R. D.
1950. extensive research program undertaken on meat curing. 2 pp., illus. Tennessee Valley Authority.

(6) United States Bureau of Agricultural Economics.
1949. agricultural statistics. 787 pp. Washington, D. C.

(7) Warner, K. F.
1949. pork on the farm, killing, curing and canning. U. S. Dept. Agr. Farmers Bull. 1186, 38 pp., illus.

(8) White, W. H., Gibbons, N. E., Woodcock, A. H., and Cook, W. H.
1942. smoked meats. bacteriological, chemical, and physical measurements on smoked and unsmoked bacon. Can. Jour. Res. Sect. D, Zool. Sci. 20 (9), 7 pp., illus.

(9) Ziegler, P. T.
1948. the meat we eat. 353 pp., illus. State College, Pa.

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 10 cents

U. S. GOVERNMENT PRINTING OFFICE: 1951